UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PESTICIDES AND TOXIC
SUBSTANCES

MEMORANDUM

SUBJECT: TRED for Tebuthiuron (Chemical # 105501, DP Barcode D279066)

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EFED has completed a drinking-water assessment for the reassessment of tolerances for the herbicide Tebuthiuron. This assessment considers Tebuthiuron, and to the extent possible, the degradate "Compound 104," which the Health Effects Division has determined is of toxicological concern. Compound 104 was the only degradate of Tebuthiuron of toxicological concern that was detected in the environmental fate studies reviewed. Tier II (PRZM version 3.12/EXAMS version 2.97.5) surface water modeling for Tebuthiuron use on rangeland/pasture at 4 pounds active ingredient per acre (lbs ai/A) using the index reservoir predicts the 1 in 10 year annual maximum (acute) concentration of 15.1 :g/L. The 1 in 10 year annual average concentration (non-cancer chronic) of Tebuthiuron is predicted to be 1.5 :g/L . The 36 year annual average concentration (cancer chronic) of Tebuthiuron is predicted to be 0.6 :g/L. SCI-GROW (version 2.1) modeling estimates the acute and chronic concentration of Tebuthiuron residues in shallow groundwater is 181 :g/L. Monitoring data was evaluated from the USGS NAWQA program and from preliminary data from the USGS Reservoir Pilot Monitoring Project. Both surface and ground water data from the NAWQA program were evaluated for annual maximum (peak) and time weighted mean concentrations. Only surface water data was available from the USGS Reservoir Pilot Monitoring study which was also evaluated for annual maximum and time weighted mean concentrations.   EFED proposes using the estimated environmental concentrations (EECs) from modeling as upper bound estimates of exposure. Acute (annual maximum) concentrations and chronic (time weighted mean) concentrations from monitoring data are summarized below. In general these concentrations are less than the estimates from modeling. EFED proposes using the model results as acute and chronic EECs for the risk assessment because Tebuthiuron is persistent and data from edge of field runoff studies conducted in the 1980's indicate concentrations higher than those found in the NAWQA and USGS Reservoir studies can occur.

Drinking water environmental concentrations for Compound 104 cannot be estimated due to a lack of fate and monitoring data . Compound 104 was detected at a maximum concentration of 0.004 mg/L in ground water in a Small Scale Retrospective study (MRID 42390901) submitted in 1992. However the concentrations were detected four years after application of Tebuthiuron and may not be representative of the maximum concentrations present beneath the site after application. Compound 104 was detected at 6.9% of applied parent at the end of the aerobic soil metabolism study but was noted to still be increasing at the end of the study. It is suspected that the percent applied of Compound 104 would have increased if the experiment had run longer. Compound 104 appears to have similar mobility to Tebuthiuron and has a long half life. Therefore, EFED is unable to estimate how much degradate might have been produced if the study had run longer.

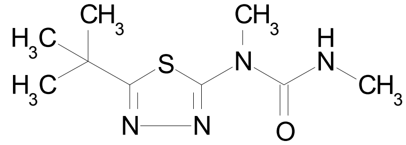
Introduction

Tebuthiuron is a non-selective herbicide used primarily on pastureland, rights-of-way, and other non-agricultural sites. Tebuthiuron is used predominantly in Texas, Oklahoma, and New Mexico based on information provided by the registrant and BEAD. Information on publically supplied drinking water available from the USGS (Selley, et al, 1998; "Estimated Use of Water in the United States in 1995". USGS Circular 1200) was reviewed. Both surface and ground water sources are used for publically supplied water in Texas, Oklahoma and New Mexico. Ground water provides approximately 89% of New Mexico's public water, while surface water provides 66% and 83% of public water to Texas and Oklahoma respectively. Reviewing population served information indicates that 88% of New Mexico's population relies on ground water while 58% of Texas and 74% of Oklahoma's population rely on surface water.

Chemical Name: N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N,N'-dimethylurea

Compound 104: N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2-yl]-N-methylurea

Chemical Structure:



Environmental Fate

As reported in the 1994 RED Tebuthiuron is persistent and mobile, and that the "principal route of dissipation appears to be transport to ground and surface water." This assessment was based on a suite of required environmental fate studies that lacked only a field dissipation study. This study has since been submitted and reviewed and found to be marginally acceptable with field dissipation half lives of 385 days (Florida), 770 days (California), and 575 days (Nebraska).

The quickest observed route of Tebuthiuron degradation in laboratory studies was soil photolysis (half-life 39.7 days.) Tebuthiuron is stable in laboratory studies to hydrolysis, aqueous photolysis, and aerobic aquatic metabolism. Tebuthiuron was also stable during a 9-month aerobic soil metabolism study, with a calculated half-life of 35.4 months.

Soil partition coefficients (Kd) from adsorption/desorption studies were 0.11, 0.62, 0.82 and 1.82, indicating that Tebuthiuron is very mobile over a range of soil types. The corresponding Koc values relating to these studies ranged from 31 to 151, with a median of 76 l/kg. The soil adsorption of Tebuthiuron appears to be related to the amount of organic carbon in the soil.

Degradate 104 (Compound 104 was the only degradate of Tebuthiuron of toxicological concern that was detected in the environmental fate studies reviewed) was at 6.9% and rising by the end of the study. That is the highest concentration of any degradate in any lab study. Based on data reviewed at the time of the RED, the degradate appears to have similar mobility to parent Tebuthiuron.

For full details of the environmental fate assessment for Tebuthiuron, see the 1994 Reregistration Eligibility Document, which can be found on the internet at http://www.epa.gov/pesticides/reregistration/status.htm.

SURFACE WATER MONITORING DATA ASSESSMENT

National NAWQA Data

The United States Geological Survey (USGS) is collecting surface and ground water data from selected watersheds in order to catalog the quality of water resources in the United States. The National Water Quality Assessment (NAWQA) program began in 1991 and consists of chemical, biological and physical water quality data from 59 study units across the United States. EFED evaluated the occurrence of Tebuthiuron in surface water from the national data set. Tebuthiuron was detected in surface water from locations in 30 states. Compared with current usage which is predominantly located in Texas, Oklahoma, and New Mexico, the occurrence in so many locations is reflective of past usage due to the persistence of Tebuthiuron. Tebuthiuron was detected above the limit of detection in 1155 samples from a total national dataset of 6625 samples (17.4%). This rate of detection is greater than for most pesticides included as analytes, in spite of its limited use. EFED analyzed the occurrence of Tebuthiuron in surface water from each sampling location within each state on an annual basis. Each year of data from an individual sample location was evaluated and the annual maximum concentration and time weighted mean were calculated. For the purposes of this assessment only the upper bound time weighted mean concentration from the NAWQA data is presented. The upper bound annual time weighted mean concentrations were estimated by setting detections at or below the detection limit at the value of the detection limit.

Analysis of the national NAWQA surface water data set for Tebuthiuron is presented below. The annual maximum concentrations ranged from 2.83 to 0.003 (estimated below limit of quantitation) :g/L and the upper bound time weighted means ranged from 0.26 to 0.00 :g/L. No degradate data was available in this dataset for analysis. The annual maximum concentrations and time weighted mean concentrations were ranked and percentiles generated for the dataset. The results of the analysis are summarized in Table 1.

Table 1 Summary of Percentiles for Surface Water Annual Maximum and Time Weighted Mean Tebuthiuron Concentrations from the National NAWQA Data.

Percentile	**National NAWQA Annual Maximum (:g/L)**	**National NAWQA Time Weighted Mean (:g/L)**
Maximum	2.83	0.26
99.9%	1.99	0.24
99%	0.21	0.06
95%	0.09	0.03
90%	0.06	0.02
50%	0.01	0.01

The analysis above includes the entire national NAWQA data which consists of surface water results from all 59 NAWQA study units. In order to assess the impact of high Tebuthiuron usage on the analysis, EFED completed an additional analysis focusing on only data from those study units located in areas of high Tebuthiuron usage. This focused assessment is intended to indicate if exposure to Tebuthiuron in surface water in those areas where the herbicide is used predominantly (i.e. Texas, Oklahoma, and New Mexico) is greater in these areas than on a national basis. The study units for the focused analysis were selected by overlaying Tebuthiuron usage data taken from registrant supplied information with the NAWQA study units.

As with the national NAWQA, the focused NAWQA data annual maximum concentrations ranged from 2.83 to 0.01 :g/L and the upper bound time weighted means ranged from 0.26 to 0.01 :g/L. No degradate data was available in this dataset for analysis. The annual maximum concentrations and time weighted mean concentrations were ranked and percentiles generated for the dataset. The results of the analysis are summarized in Table 2. Analysis of surface water data from those locations where Tebuthiuron usage is higher indicates that while the range of concentrations is the same for both annual maximum and time weighted mean, the concentrations at the higher percentiles (> 90%) are higher for the focused data.

Table 2 Summary of Percentiles for Surface Water Annual Maximum and Time Weighted Mean Tebuthiuron Concentrations from the Focused NAWQA Data.

Percentile	Focused NAWQA Annual Maximum (: g/L)	Focused NAWQA Time Weighted Mean (: g/L)
Maximum	2.83	0.26
99.9%	2.77	0.26
99%	2.27	0.25
95%	0.69	0.19
90%	0.33	0.05
50%	0.01	0.01

USGS Reservoir and Finished Water - Pilot Monitoring Study, 1999-2000

The USGS recently issued preliminary data from a cooperative study between the USGS and USEPA for "Pesticides in Water-supply Reservoirs and Finished Drinking Water - A Pilot Monitoring Program". The study consists of the analysis of samples from 12 drinking water reservoirs across the United States (including Texas and Oklahoma). EFED has reviewed the preliminary data for the occurrence of Tebuthiuron. Tebuthiuron was analyzed in all samples using the same analytical methodology as the USGS NAWQA program (Schedule 2001). Degradates of Tebuthiuron were not analyzed in this study. Source water samples were collected from drinking water intakes within each reservoir and treated water samples were collected post-treatment. Treated and intake samples were typically collected on the same date within several hours of each other. In addition, samples were collected and analyzed from the reservoir outfall (untreated) from selected locations. Several outfall locations coincide with source water intakes and therefore the intake and outfall samples are the same.

Tebuthiuron was detected in 232 out of 627 analysis for a detection frequency of 37%. The highest peak concentration of Tebuthiuron was 0.032 : g/L detected in the treated water of the Oklahoma Reservoir. The maximum concentrations and time weighted mean concentrations were calculated for each subset of the data (intake, treated, and outfall) for each location. The results are presented in Table 3 and 4. In addition, the maximum concentrations and time weighted mean concentrations were ranked and percentiles generated for the data set. The results of ranking are presented in Tables 5 and 6.

Table 3 Summary of Time Weighted Mean Tebuthiuron Concentrations from the USGS Reservoir Data from 1999-2000.

State	Intake Sample Time Weighted Mean (: g/L)	Treated Sample Time Weighted Mean (: g/L)	Reservoir Outfall Time Weighted Mean (: g/L)
SD	0.011	0.010	0.009
NY	0.010	0.011	
OH	0.011	0.010	0.011
CA	0.009	0.010	
TX	0.008	0.008	
LA	0.010	0.010	0.010
NC	0.010	0.010	
OK	0.018	0.020	0.011
MO	0.009	0.011	0.008
PA	0.008	0.008	
SC	0.008	0.008	0.008
IN	0.011	0.011	0.006

Table 4 Summary of Maximum Tebuthiuron Concentrations from the USGS Reservoir Data from 1999-2000.

State	Intake Sample Maximum (: g/L)	Treated Sample Maximum (: g/L)	Reservoir Outfall Maximum (: g/L)
SD	0.016	0.016	0.010
NY	0.016	0.016	
OH	0.015	0.010	0.012
CA	0.012	0.018	
TX	0.010	0.010	
LA	0.016	0.016	0.010
NC	0.011	0.010	
OK	0.030	0.032	0.024
MO	0.010	0.016	0.010
PA	0.020	0.010	
SC	0.010	0.016	0.010
IN	0.016	0.016	0.020

Table 5 Summary of Percentiles for Surface Water Annual Time Weighted Mean Tebuthiuron Concentrations from the USGS Reservoir Data from 1999-2000.

Percentile	Time Weighted Mean Concentration from Intake Samples (: g/L)	Time Weighted Mean Concentration from Treated Samples	Time Weighted Mean Concentration from Outfall Samples (: g/L)
Maximum	0.018	0.020	0.011
99.9%	0.018	0.020	0.011
99%	0.017	0.019	0.011
95%	0.014	0.015	0.011
90%	0.011	0.011	0.011
50%	0.010	0.010	0.009

Table 6 Summary of Percentiles for Surface Water Maximum Tebuthiuron Concentrations from the USGS Reservoir Data from 1999-2000.

Percentile	Maximum Concentration from Intake Samples (: g/L)	Maximum Concentration from Treated Samples (: g/L)	Maximum Concentration from Outfall Samples (: g/L)
Maximum	0.030	0.032	0.024
99.9%	0.030	0.032	0.024
99%	0.029	0.030	0.024
95%	0.025	0.024	0.023
90%	0.020	0.018	0.022
50%	0.016	0.016	0.010

The data above indicate that Tebuthiuron is found at a high frequency of detection (greater than 17% in NAWQA data and greater than 37% in the USGS Reservoir data). The maximum concentration detected in these two studies is 2.83 ppb from the NAWQA study. Time weighting of these data indicate that long term exposure is generally less than 1 ppb. The high frequency of detection is likely a function of the persistence of Tebuthiuron in the environment. The low concentrations detected (compared with edge of field studies discussed below) may be a function of the use of Tebuthiuron which is focused on rangeland/pasture which is typically in arid and semi-arid environments and is not likely applied in proximity to surface water bodies assessed by NAWQA and USGS Reservoir studies.

Additional Monitoring Data

Four supplemental watershed/runoff studies were conducted in Idaho, Oklahoma, Texas, and Arizona between 1980 and 1984. The four studies represent typical application scenarios for the time with variable rates of application between 1 and 3 lbs a.i./acre. The maximum label rate is 4 lbs a.i./acre suggesting that these studies do not represent a worse case scenario. Tebuthiuron was applied to varying percentages of four small watersheds ranging between 13 acres (Oklahoma) to 303 acres (Arizona). Surface water and "hydrosoil" samples were collected up to 9 months after application at the Idaho site (24 samples), 7 months after application at the Oklahoma site (7 samples), 7 months after application at the Texas site (6 samples), and 3 months after application at the Arizona site (53 samples).

Analytical results from the four watershed/runoff studies reported concentrations of Tebuthiuron in surface water ranging from less than 1 : g/L (measured at the conclusion of the Texas study) up to 180 : g/L (measured 5/5/81 in the Oklahoma study) and hydrosoil residues from < 50 : g/L up to 140 : g/L. EFED revisited the analytical data from the four runoff studies in Idaho, Oklahoma, Texas, and Arizona. Analysis of the data from 1980 through 1981 indicate that the maximum concentration detected for each site respectively is 180 : g/L for Oklahoma, 14 : g/L for Idaho, 70 : g/L for Texas, and 54 : g/L for Arizona. Time weighted mean concentrations were calculated for each dataset with the results showing 98 : g/L in Oklahoma, 7 : g/L in Idaho, 37 : g/L in Texas, and 24 : g/L in Arizona. These concentrations are higher than those observed in other surface water monitoring studies (NAWQA and USGS Reservoir Pilot Monitoring) and those concentrations predicted using PRZM/EXAMS. The samples analyzed were collected from catchment/weir ponds within a watershed unlike the other surface water monitoring data which is generally collected from flowing streams and drinking water reservoirs. The concentrations from these runoff studies are better compared to the edge of field effect predicted by PRZM/EXAMS. The comparison with PRZM/EXAMS suggests that the modeling may under predict the concentrations that would be expected in a waterbody adjacent to a treatment area.

GROUND WATER MONITORING DATA ASSESSMENT

A small scale retrospective ground water monitoring study was completed on a rangeland site at a ranch near Sarita, Texas. The study was conducted in a portion of a 540 acre area treated with Tebuthiuron in March 1986 by aerial broadcast in 70 foot wide strips. Tebuthiuron was applied at rates between 1.5 and 1.75 lbs a.i./acre for rangeland brush control. Higher application up to 2 lbs a.i./acre were applied in bands to thick stands of live oak and along fence lines. In some areas at the site overlap of rangeland and fence line treatments resulted in total application of up to 4 lbs a.i./acre.

A total of 16 soil borings, 14 test pits, and 5 ground water monitoring wells were performed to complete site characterization. The site characterization gives a high level of confidence that this study was performed with a reasonable "high exposure" scenario. The site is comprised of eolian sands over fluvial deposits. Monitoring wells were installed to avoid discontinuous, restrictive clay layers that are found beneath some portions of the site.

Using the site characterization data, a study protocol was developed and field work began in May 1990 and included the installation of an additional 5 ground water monitoring wells. A program of ground water analysis was begun in which seven of the ten ground water monitoring wells were sampled every other month beginning in June 1990 and ending June 1991.

Analysis of soil samples indicated that Tebuthiuron was still present in soil at depths greater than three feet below ground surface and appeared to be in contact with shallow ground water beneath portions of the study site. No degradate was detected in soil samples above the limit of detection of 0.01 mg/L. The data suggest that Tebuthiuron is persistent and mobile in soil at the study site.

Analysis of ground water samples collected beneath the study site indicate that Tebuthiuron was present above the limit of detection (0.001 mg/L) in six of the seven wells at the site and was detected above the limit of quantitation (0.003 mg/L) in three of the seven wells with a maximum concentration of 0.023 mg/L four years after application. Compound 104 was detected above the limit of detection in three wells and was detected at concentrations above the limit of quantitation in one well with a maximum concentration of 0.004 mg/L four years after application. This data indicate that Tebuthiuron and its primary degradate are persistent and mobile in ground water up to four years after application.

NAWQA Data

EFED evaluated the occurrence of Tebuthiuron in ground water from the national data set. Tebuthiuron was detected in 228 ground water samples out of a total of 5303 samples (4.3%). It is difficult to compare analytical results from ground water monitoring wells within a given geographic area. A significant amount of ancillary data is necessary in order to compare wells across an area. Examples of the data that is needed is aquifer type, well construction, and sampling methodology. Even with ancillary data it is difficult to compare analytical results within a region due to variations in geology, geochemistry of ground water, and groundwater usage patterns and history. Because this information is not readily available for this data set, EFED has conducted a general analysis of the data. The maximum concentration detected across all samples is 17.3 :g/L with a detection limit of 0.010 :g/L, while the average concentration among all reported Tebuthiuron data is 0.016 :g/L. Depth to ground water across the entire NAWQA data ranged from near surface to greater than 600 feet below ground surface with an average depth of 33 feet below ground surface. Depth to ground water in the focused NAWQA study units from Texas, Oklahoma, and New Mexico ranged from 2 to 177 feet below ground surface with an average depth of 17 feet below ground surface. The depth to ground water data suggest that the peak and average concentrations are representative of the shallowest aquifers.

SURFACE, GROUND AND DRINKING WATER ASSESSMENT

Because Tebuthiuron is not included among regulated or unregulated chemicals required as analytes in testing of public drinking water supplies, drinking-water monitoring results are not available. Therefore, drinking water exposure assessments are supplemented with modeling predictions. Surface water concentrations of Tebuthiuron were modeled using the

PRZM/EXAMS (Tier II) programs for pasture/rangeland using EFEDs standard scenario for alfalfa in Texas. The alfalfa scenario was chosen because its hydrologic and agronomic practices closely match those of pasture/rangeland. Groundwater concentrations were modeled using the SCI-GROW program. Input parameters used Tier II (PRZM version 3.12/EXAMS version 2.97.5) modeling were selecting using Agency guidance ("*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated August 6, 2000) and EFED calculated degradation rate constants from review of registrant submitted environmental fate studies. The assessment strategy was designed to assess concentrations of the parent compound alone.

Tier II **(**PRZM-EXAMS) surface water modeling for Tebuthiuron (parent only) using the index reservoir with the percent cropped area (PCA=0.87 for default PCA) estimates the concentration of Tebuthiuron is not likely to exceed the concentrations in Table 7.

Table 7. PRZM-EXAMS Predicted Parent Tebuthiuron Concentrations in the Index Reservoir

Simulation Scenarios		**Concentration (: g/L)**						
		1 in 10 year						**Mean of Annual Means**
Crop and Location	**Scenario**	**Peak**	**96 Hour**	**21 Day**	**60 Day**	**90 Day**	**Annual Mean**	
Pasture, Milam Co., TX	Index Reservoir	17.4	16.6	13.2	8.1	6.0	1.7	0.7
	Index Reservoir w/PCA (0.87)	15.1	14.4	11.5	7.0	5.2	1.5	0.6

SCI-GROW predicts a concentration of Tebuthiuron in shallow ground water of 181 µg/L. Appendix A provides a detailed discussion of the modeling efforts for PRZM/EXAMS and SCI-GROW.

APPENDIX A

MODELING DISCUSSION

DRINKING WATER ASSESSMENT

Uncertainties, Assumptions and Limitations

Input parameters used in Tier II (PRZM/EXAMS) modeling were selecting using Agency guidance ("*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of*" dated August 6, 2000) and EFED calculated degradation rate constants from review of registrant submitted environmental fate studies.

Tebuthiuron is used primarily on pasture and rangeland in Texas, Oklahoma, and New Mexico, therefore, only one scenario was simulated to estimate runoff concentrations. EFED selected a scenario in Texas for alfalfa representing an EFED standard scenario developed for use in modeling the respective crops. Alfalfa was selected as the scenario most closely representing pasture/rangeland (the alfalfa scenario was developed based on a pasture setting). These scenarios were developed to approximately represent the 90th percentile site for runoff vulnerability in a high usage state. Application timing was taken from registrant provided information and recent labels.

The standard scenario for alfalfa is based on usage patterns in Milam County, Texas. The soil is a Lufkin sandy loam in Major Land Use Area (MLRA) 87. The Lufkin sandy loam is characterized as a Hydrologic Group D soil.

The index reservoir represents potential drinking water exposure from a specific area with specific cropping patterns, weather, soils, and other factors (use of an index reservoir for areas with different climates, crops, pesticides used, sources of water, and hydrogeology creates uncertainties). If a community derives its drinking water from a large river, then the estimated exposure would likely be higher than the actual exposure. Conversely, a community that derives its drinking water from smaller bodies of water with minimal outflow would likely get higher drinking water exposure than estimated using the index reservoir. Areas with a less humid climate that use a similar reservoir and cropping patterns would likely get less pesticides in their drinking water than predicted levels. A single steady flow has been used to represent the flow through the reservoir. Discharge from the reservoir also removes chemical from it so this assumption will underestimate removal from the reservoir during wet periods and overestimates removal during dry periods. This assumption can both underestimate or overestimate the concentration in the pond depending upon the annual precipitation pattern at the site. The index reservoir scenario uses the characteristic of a single soil to represent the soil in the basin. In fact, soils can vary substantially across even small areas, and thus, this variation is not reflected in these simulations. The index reservoir scenario does not consider tile drainage. Areas that are prone to substantial runoff are often tile drained. This may underestimate exposure, particularly on a chronic basis. EXAMS is unable to easily model spring and fall turnover which results in complete mixing of the chemical through the water column at these times. Because of this inability, Shipman City Lake has been simulated without stratification. There is data to suggest that Shipman City Lake does indeed stratify in the deepest parts of the lake at least in some years. This may result in both over and underestimation of the concentration in drinking water depending upon the time of the year and the depth the drinking water intake is drawing from.

PRZM/EXAMS is a field-scale model which treats watersheds as large fields. It assumes that the entire area of the watershed is planted with the crop of interest (i.e., 100% crop coverage). This assumption may not hold for areas larger than a few hectares, such as watersheds containing drinking water reservoirs. Therefore, pesticide concentrations (peak and/or long-term average) were estimated with PRZM/EXAMS (the index reservoir modification changes the surface water body parameters used in EXAMS) and the model results from PRZM/EXAMS were adjusted by a factor that represents the maximum percent crop area found for the crop or crops being evaluated. Percent crop areas (PCAs) were derived on a watershed basis with GIS tools using 1992 Census of Agriculture data and 8-digit Hydrologic Unit Code (HUC) coverage for the coterminous United States. The maximum PCA derived from this project was selected to represent the modeled crop or crops. The PCA assumes the distribution of the crops within a county is uniform and homogeneous throughout the county area. Distance between the treated fields and the water body is not addressed.

The PCA is a watershed-based modification. Implicit in its application is the assumption that currently-used field-scale models reflect basin-scale processes consistently for all pesticides and uses. In other words, we assume that the large field simulated by the coupled PRZM and EXAMS models is a reasonable approximation of pesticide fate and transport within a watershed that contains a drinking water reservoir. If the models fail to capture pertinent basin-scale fate and transport processes consistently for all pesticides and all uses, the application of a factor that reduces the estimated concentrations predicted by modeling could, in some instances, result in inadvertently passing a chemical through the screen that may actually pose a risk. Some preliminary assessments made in the development of the PCA suggest that PRZM/EXAMS may not be realistically capturing basin-scale processes for all pesticides or for all uses. A preliminary survey of water assessments which compared screening model estimates to readily available monitoring data suggest uneven model results. In some instances, the screening model estimates are more than an order of magnitude greater than the highest concentrations reported in available monitoring data; in other instances, the model estimates are less than monitoring concentrations. Because of these concerns, the SAP recommended using the PCA only for "major" crops in the South. For other crops, development of PCAs will depend on the availability of relevant monitoring data that could be used to evaluate the result of the PCA adjustment.

Table A-1. Input Parameters for Tebuthiuron for PRZM (Version 3.12) for Index Reservoir and PCA.

Variable Description	Variable (Units)	Input Value	Source of Info/Reference
Application date(s) (day/mo/yr)	APD, APM, IAPYR (day/mo/yr)	1 times per year	Product label or location-specific
Incorporation depth	DEPI (cm)	0	Product label
Application rate	TAPP (kg a.i. ha^{-1})	4.48 Aerial granular	Product label
Application efficiency	APPEFF (decimal)	1.00	Spray Drift Task Force Data
Spray drift fraction: For aquatic ecological exposure assessment, use 0.05 for aerial spray; 0.01 for ground spray. For drinking water assessment, use 0.16 for aerial 0.064 for ground spray.	DRFT (decimal)	0.00	Spray Drift Task Force Data
Foliar extraction	FEXTRA (frac./cm rain)	0.5 (default)	Default or field data
Decay rate on foliage	PLDKRT (day $^{-1}$)	0.0 (default)	Default or field data
Volatilization rate from foliage	PLVKRT (day $^{-1}$)	0.0 (default)	Default or field data
Plant uptake factor	UPTKF (frac. of evap)	0.0 (default)	Default or field data
Dissolved phase pesticide decay rate in surface horizon **(aerobic soil metabolism)**	DWRATE (surface) (day^{-1})	$T_{1/2}$ =>1060 days Rate constant = 0.00065/day	MRID 41328001
Adsorbed phase pesticide decay rate in surface horizon **(aerobic soil metabolism)**	DSRATE (surface) (day^{-1})	$T_{1/2}$ =>1060 days Rate constant = 0.00065/day	MRID 41328001
Dissolved phase pesticide decay rate in subsequent subsurface horizons **(aerobic or anaerobic soil metabolism)**	DWRATE (subsurface horizons) (day^{-1})	$T_{1/2}$ =>1060 days Rate constant = 0.00065/day	MRID 41328001
Adsorbed phase pesticide decay rate in subsequent subsurface horizons **(aerobic or anaerobic soil metabolism)**	DSRATE (subsurface horizons) (day^{-1})	$T_{1/2}$ =>1060 days Rate constant = 0.00065/day	MRID 41328001
Pesticide partition or distribution coefficients for each horizon **(Leaching/Adsorption/Desorption)**	Kd	0.84 Average Kd	MRID 40768401

Table A-2. Input Parameters for Tebuthiuron.chm Files Used in EXAMS (Version 2.97. 5) for Index Reservoir and PCA.

Variable Description	Variable (Units)	Input Value	Source of Info/Reference
Henry's law constant	HENRY (atm-$m^3$$mole^{-1}$)	2.4 x 10^{-10} Atm m^3/mol	From registrant or product chemistry
Bacterial biolysis in water column **(aerobic aquatic metabolism)**	KBACW $(cfu/mL)^{-1}$ $hour^{-1}$	30 days Rate constant =0.00096/hr	MRID 41372501
Bacterial biolysis in benthic sediment **(anaerobic aquatic or aerobic aquatic metabolism)**	KBACS[1] $(cfu/mL)^{-1}$ $hour^{-1}$	365 days	MRID 41913101
Direct photolysis **(aqueous photolysis)**	KDP ($hour^{-1}$)	$T_{1/2}$ =30 days Rate constant =0.00096/hr	MRID 41365101
Base hydrolysis	KBH ($mole^{-1}$ $hour^{-1}$)	30 days (stable) Rate constant =0.00096/hr	1994 RED
Neutral hydrolysis	KNH ($mole^{-1}$ $hour^{-1}$)	30 days (stable) Rate constant =0.00096/hr	1994 RED
Acid hydrolysis	KAH ($mole^{-1}$ $hour^{-1}$)	30 days (stable) Rate constant =0.00096/hr	1994 RED
Partition coefficient for sediments **(Leaching/Adsorption/Desorption)** need Kd from soil closest to crop scenario	KPS (mL g^{-1} or L kg^{-1})	Kd = 0.84 Average Kd	MRID 40768401
Molecular weight	MWT (g $mole^{-1}$)	228.3	From registrant or product chemistry
Aqueous solubility **(Multiply water solubility by 10)**	SOL (mg L^{-1}) = 0.800	2,500 ppm @ 20°C	From registrant or product chemistry
Vapor pressure	VAPR (torr)	2 x 10^{-6} Torr	From registrant or product chemistry
Sediment bacteria temperature coefficient	QTBAS	2	Standard value
Water bacteria temperature coefficient	QTBAW	2	Standard value

Table A-3. PRZM-EXAMS Predicted Tebuthiuron Concentrations in the Index Reservoir

Simulation Scenarios		**Concentration (:g/L)**						
		1 in 10 year						**Mean of Annual Means**
Crop and Location	**Scenario**	**Peak**	**96 Hour**	**21 Day**	**60 Day**	**90 Day**	**Annual Mean**	
Pasture, Milam Co., TX	Index Reservoir	17.4	16.6	13.2	8.1	6.0	1.7	0.7
	Index Reservoir w/PCA (0.87)	15.1	14.4	11.5	7.0	5.2	1.5	0.6

```
TX Alfalf - 08/06/2001
" Texas Claypan Area, Milam County, Texas; MLRA J-87"
*** Record 3:
   0.71    0.36       0      25       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.43   0.109       1     172.8            4       1     600
*** Record 8
      1
*** Record 9
      1    0.25     100     100       1  90  88  89       0      76
*** Record 9a-d
      1      26
0101 1601 0102 1602 0103 1503 1603 0104 1604 0105 1605 0106 1506 1606 0107 1607
.003 .003 .003 .004 .004 .004 .003 .001 .000 .001 .001 .000 .001 .001 .000 .000
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110 .110
0108 1608 0109 1609 0110 1610 0111 1611 0112 1612
.001 .000 .000 .001 .001 .002 .002 .002 .003 .003
.110 .110 .110 .110 .110 .110 .110 .110 .110 .110
*** Record 10 -- NCPDS, the number of cropping periods
     36
*** Record 11
  300847  201047  010848       1
  300848  201048  010849       1
  300849  201049  010850       1
  300850  201050  010851       1
  300851  201051  010852       1
  300852  201052  010853       1
  300853  201053  010854       1
  300854  201054  010855       1
  300855  201055  010856       1
  300856  201056  010857       1
  300857  201057  010858       1
  300858  201058  010859       1
  300859  201059  010860       1
  300860  201060  010861       1
  300861  201061  010862       1
  300862  201062  010863       1
  300863  201063  010864       1
  300864  201064  010865       1
  300865  201065  010866       1
  300866  201066  010867       1
  300867  201067  010868       1
  300868  201068  010869       1
  300869  201069  010870       1
```

```
 300870  201070  010871       1
 300871  201071  010872       1
 300872  201072  010873       1
 300873  201073  010874       1
 300874  201074  010875       1
 300875  201075  010876       1
 300876  201076  010877       1
 300877  201077  010878       1
 300878  201078  010879       1
 300879  201079  010880       1
 300880  201080  010881       1
 300881  201081  010882       1
 300882  201082  010883       1
*** Record 12 -- PTITLE
Tebuthiuron - 1 applications @ 4.48 kg/ha
*** Record 13
    36       1       0       0
*** Record 15 -- PSTNAM
Tebuthiuron
*** Record 16
 050648  0 8    2  4.48    1    0
 050649  0 8    2  4.48    1    0
 050650  0 8    2  4.48    1    0
 050651  0 8    2  4.48    1    0
 050652  0 8    2  4.48    1    0
 050653  0 8    2  4.48    1    0
 050654  0 8    2  4.48    1    0
 050655  0 8    2  4.48    1    0
 050656  0 8    2  4.48    1    0
 050657  0 8    2  4.48    1    0
 050658  0 8    2  4.48    1    0
 050659  0 8    2  4.48    1    0
 050660  0 8    2  4.48    1    0
 050661  0 8    2  4.48    1    0
 050662  0 8    2  4.48    1    0
 050663  0 8    2  4.48    1    0
 050664  0 8    2  4.48    1    0
 050665  0 8    2  4.48    1    0
 050666  0 8    2  4.48    1    0
 050667  0 8    2  4.48    1    0
 050668  0 8    2  4.48    1    0
 050669  0 8    2  4.48    1    0
 050670  0 8    2  4.48    1    0
 050671  0 8    2  4.48    1    0
 050672  0 8    2  4.48    1    0
 050673  0 8    2  4.48    1    0
```

```
 050674  0 8    2  4.48    1    0
 050675  0 8    2  4.48    1    0
 050676  0 8    2  4.48    1    0
 050677  0 8    2  4.48    1    0
 050678  0 8    2  4.48    1    0
 050679  0 8    2  4.48    1    0
 050680  0 8    2  4.48    1    0
 050681  0 8    2  4.48    1    0
 050682  0 8    2  4.48    1    0
 050683  0 8    2  4.48    1    0
*** Record 17
      0       1       0
*** Record 19 -- STITLE
Lufkin Sandy Loam; HYDG: D
*** Record 20
    100          0   0   0   0   0   0   0   0   0
*** Record 26
      0       0       0
*** Record 33
      3
      1      10    1.55   0.215       0       0       0
       0.0006540.000654       0
           0.1   0.215   0.105    1.16    0.84
      2       8    1.55   0.215       0       0       0
       0.0006540.000654       0
             1   0.215   0.105    1.16    0.84
      3      82     1.6    0.32       0       0       0
       0.0006540.000654       0
             2    0.32     0.2    0.29    0.84
***Record 40
      0
          YEAR      10           YEAR      10           YEAR      10   1
      1
      1  -----
      7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

```
SET MODE = 3
CHEM NAME IS Tebuthiuron
Read ENV c:\mark\przmexam\exam\irtxalf.exv
SET MWT(*) =   228.3
SET SOL(*,*) = 2500.0
SET PRBEN = 0.05
SET VAPR(1)=0.20E-05
SET KBACW(*,*,1)=0.00096
SET KBACS(*,*,1)=0.0
SET QTBAS(*,*,1)=2.0
SET QTBAW(*,*,1)=2.0
SET KDP(*,1)=0.00096
SET KBH(*,*,1)=0.000
SET KNH(*,*,1)= 0.000
SET KAH(*,*,1)= 0.000
SET KPS(*,1)= 0.84

SET YEAR1 = 1948
READ PRZM P2E-C1.D48
RUN
READ PRZM P2E-C1.D49
CONTINUE
READ PRZM P2E-C1.D50
CONTINUE
READ PRZM P2E-C1.D51
CONTINUE
READ PRZM P2E-C1.D52
CONTINUE
READ PRZM P2E-C1.D53
CONTINUE
READ PRZM P2E-C1.D54
CONTINUE
READ PRZM P2E-C1.D55
CONTINUE
READ PRZM P2E-C1.D56
CONTINUE
READ PRZM P2E-C1.D57
CONTINUE
READ PRZM P2E-C1.D58
CONTINUE
READ PRZM P2E-C1.D59
CONTINUE
READ PRZM P2E-C1.D60
CONTINUE
READ PRZM P2E-C1.D61
CONTINUE
```

READ PRZM P2E-C1.D62
CONTINUE
READ PRZM P2E-C1.D63
CONTINUE
READ PRZM P2E-C1.D64
CONTINUE
READ PRZM P2E-C1.D65
CONTINUE
READ PRZM P2E-C1.D66
CONTINUE
READ PRZM P2E-C1.D67
CONTINUE
READ PRZM P2E-C1.D68
CONTINUE
READ PRZM P2E-C1.D69
CONTINUE
READ PRZM P2E-C1.D70
CONTINUE
READ PRZM P2E-C1.D71
CONTINUE
READ PRZM P2E-C1.D72
CONTINUE
READ PRZM P2E-C1.D73
CONTINUE
READ PRZM P2E-C1.D74
CONTINUE
READ PRZM P2E-C1.D75
CONTINUE
READ PRZM P2E-C1.D76
CONTINUE
READ PRZM P2E-C1.D77
CONTINUE
READ PRZM P2E-C1.D78
CONTINUE
READ PRZM P2E-C1.D79
CONTINUE
READ PRZM P2E-C1.D80
CONTINUE
READ PRZM P2E-C1.D81
CONTINUE
READ PRZM P2E-C1.D82
CONTINUE
READ PRZM P2E-C1.D83
CONTINUE
Tebuthiuron on Pasture in Texas

WATER COLUMN DISSOLVED CONCENTRATION (PPB)

YEAR	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY
1948	4.558	4.303	3.627	2.252	1.678	0.491
1949	1.216	1.148	0.928	0.598	0.445	0.137
1950	10.440	9.861	7.831	4.873	3.605	0.958
1951	21.420	20.230	16.060	9.896	7.466	2.015
1952	9.117	8.612	6.840	4.257	3.149	0.871
1953	1.768	1.667	1.292	0.788	0.586	0.179
1954	0.148	0.139	0.109	0.072	0.056	0.023
1955	9.022	8.536	6.810	4.244	3.140	0.854
1956	0.178	0.168	0.133	0.082	0.065	0.034
1957	9.876	9.328	7.405	4.575	3.386	0.872
1958	4.589	4.334	3.435	2.109	1.567	0.455
1959	4.282	4.044	3.158	1.989	1.485	0.430
1960	17.050	16.270	12.910	7.886	5.853	1.724
1961	5.934	5.671	4.674	2.912	2.156	0.707
1962	16.330	15.490	12.420	7.693	5.694	1.553
1963	0.679	0.642	0.511	0.314	0.233	0.095
1964	9.273	8.762	7.099	4.369	3.235	0.870
1965	1.998	1.887	1.499	0.933	0.697	0.201
1966	3.022	2.854	2.266	1.400	1.041	0.291
1967	3.743	3.509	2.710	1.747	1.370	0.391
1968	0.294	0.282	0.225	0.138	0.103	0.049
1969	9.944	9.392	7.351	4.667	3.694	1.060
1970	0.232	0.227	0.206	0.167	0.143	0.055
1971	8.399	7.933	6.245	3.891	2.909	0.808
1972	5.950	5.620	4.455	2.741	2.031	0.587
1973	3.450	3.304	2.655	1.641	1.215	0.354
1974	1.165	1.108	0.878	0.558	0.431	0.139
1975	4.268	4.034	3.206	1.986	1.470	0.438
1976	5.716	5.398	4.275	2.646	1.968	0.585
1977	0.300	0.283	0.222	0.136	0.109	0.057
1978	18.300	17.290	13.730	8.536	6.323	1.642
1979	2.098	1.967	1.660	1.234	1.057	0.346
1980	0.203	0.191	0.150	0.099	0.078	0.034
1981	33.920	32.280	25.780	15.920	11.780	3.384
1982	5.063	4.782	4.043	2.524	1.871	0.570
1983	2.171	2.050	1.633	1.031	0.765	0.224

SORTED FOR PLOTTING

PROB	PEAK	96 HOUR	21 DAY	60 DAY	90 DAY	YEARLY

0.027	33.920	32.280	25.780	15.920	11.780	3.384
0.054	21.420	20.230	16.060	9.896	7.466	2.015
0.081	18.300	17.290	13.730	8.536	6.323	1.724
0.108	17.050	16.270	12.910	7.886	5.853	1.642
0.135	16.330	15.490	12.420	7.693	5.694	1.553
0.162	10.440	9.861	7.831	4.873	3.694	1.060
0.189	9.944	9.392	7.405	4.667	3.605	0.958
0.216	9.876	9.328	7.351	4.575	3.386	0.872
0.243	9.273	8.762	7.099	4.369	3.235	0.871
0.270	9.117	8.612	6.840	4.257	3.149	0.870
0.297	9.022	8.536	6.810	4.244	3.140	0.854
0.324	8.399	7.933	6.245	3.891	2.909	0.808
0.351	5.950	5.671	4.674	2.912	2.156	0.707
0.378	5.934	5.620	4.455	2.741	2.031	0.587
0.405	5.716	5.398	4.275	2.646	1.968	0.585
0.432	5.063	4.782	4.043	2.524	1.871	0.570
0.459	4.589	4.334	3.627	2.252	1.678	0.491
0.486	4.558	4.303	3.435	2.109	1.567	0.455
0.514	4.282	4.044	3.206	1.989	1.485	0.438
0.541	4.268	4.034	3.158	1.986	1.470	0.430
0.568	3.743	3.509	2.710	1.747	1.370	0.391
0.595	3.450	3.304	2.655	1.641	1.215	0.354
0.622	3.022	2.854	2.266	1.400	1.057	0.346
0.649	2.171	2.050	1.660	1.234	1.041	0.291
0.676	2.098	1.967	1.633	1.031	0.765	0.224
0.703	1.998	1.887	1.499	0.933	0.697	0.201
0.730	1.768	1.667	1.292	0.788	0.586	0.179
0.757	1.216	1.148	0.928	0.598	0.445	0.139
0.784	1.165	1.108	0.878	0.558	0.431	0.137
0.811	0.679	0.642	0.511	0.314	0.233	0.095
0.838	0.300	0.283	0.225	0.167	0.143	0.057
0.865	0.294	0.282	0.222	0.138	0.109	0.055
0.892	0.232	0.227	0.206	0.136	0.103	0.049
0.919	0.203	0.191	0.150	0.099	0.078	0.034
0.946	0.178	0.168	0.133	0.082	0.065	0.034
0.973	0.148	0.139	0.109	0.072	0.056	0.023
1/10	17.425	16.576	13.156	8.081	5.994	1.667

MEAN OF ANNUAL VALUES = 0.652
STANDARD DEVIATION OF ANNUAL VALUES = 0.696
UPPER 90% CONFIDENCE LIMIT ON MEAN = 0.824

RUN No. 2 FOR Tebuthiuron INPUT VALUES

```
--------------------------------------------------------------------
 APPL (#/AC)  APPL.  URATE    SOIL    SOIL  AEROBIC
 RATE         NO. (#/AC/YR)  KOC   METABOLISM (DAYS)
--------------------------------------------------------------------
   4.000      1      4.000      72.0     1060.0


 GROUND-WATER SCREENING CONCENTRATIONS IN PPB
--------------------------------------------------------
            181.451200
--------------------------------------------------------
A=  1055.000  B=    77.000  C=     3.023  D=     1.886  RILP=     6.390
F=     1.657  G=    45.363  URATE=     4.000  GWSC=     181.451200
```